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Recycling and Reinforcing Intimomedial Flap of the infrarenal Aorta using Anterior Longitudinal Ligament in Patients with acute Trauma with Bowel Injuries

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Abstract

We present a patient with blunt abdominal trauma with severe acute right limb ischemia and clinical signs of diffuse peritonitis. Computed tomography angiography showed circumferential dissection of the infrarenal aorta with occlusion of the right common iliac artery. We opted for simultaneous abdomen exploration and open repair of injured aorta. Critical weakening of the aortic wall with imminent rupture was identified intraoperatively. Aortotomy cranially from bifurcation showed circumferential intimomedial dissection. The fixation of fragile intimomedial flap of aortic dissection was achieved with reinforcement using an anterior longitudinal ligament. The long aortoiliac arteriotomy was repaired using a great saphenous vein patch. Patient had uneventful postoperative course and was discharged after 7 days. In patients with abdominal polytrauma with peritonitis, and no available endovascular tools, open surgery for circumferential aortic dissection is possible and successful. Described reinforcement of the posterior aortic wall to the anterior longitudinal ligament should be added to the armamentarium of aortic injury treatment.

Keywords

blunt abdominal aortic injury, dissection, anterior longitudinal ligament

Introduction

Injuries of the abdominal aorta are rare due to its anatomical location and are often associated with other injuries. Blunt traumatic abdominal aorta disruption (BTAAD) occurs predominantly within the aortic segment between the inferior mesenteric artery and aortic bifurcation.¹ Abdominal aorta injuries are associated with about 80% mortality,² with the majority of injured dying on the site of injury or during transport. In-hospital mortality of injured with BTAAD ranges from 18% to 37%.^{3,4} The mortality depends on the type of injury, severity of coinjuries, patient's general condition, adequate diagnosis, and treatment.⁵ Despite widespread use of endovascular modalities to treat aortic injuries, the open surgical treatment still has significant role in the treatment of these patients.⁶ We present a patient with combined bowel injury and acute circumferential intimomedial dissection of the infrarenal aorta with acute right iliac artery occlusion.

Case Report

A 51-year-old man was admitted to the emergency unit 3 hours after traffic accident that resulted in abdomen compression by a

tractor against the house wall. Physical examination revealed cold and pale right leg without palpable artery pulses. Patient had signs of diffuse peritonitis. Preoperative checkup showed hemodynamically stable patient with blood pressure and 2 episodes of arterial hypertension (systolic pressure up to 200 mm Hg). Laboratory findings were normal. Computed tomography angiography (CTA) showed normal aorta with right common iliac artery (CIA) thrombosis caused by several posterolateral flaps, located 3 to 5 cm cranial from aortic bifurcation (Figure 1). Mechanism of injury, signs of peritonitis, and potential other abdominal injuries were the indication for open surgery.

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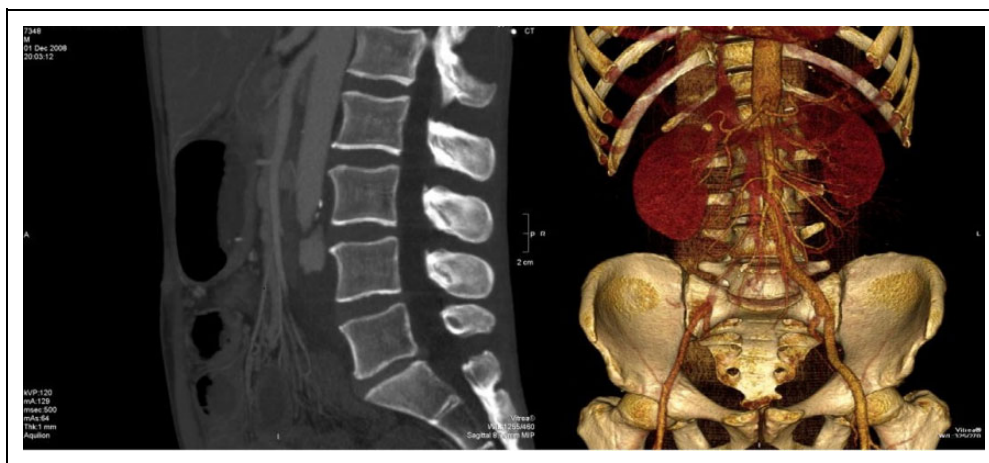


Figure 1. A, Circumferential intimal flaps at the level of the terminal aorta. B, Right common iliac artery (CIA) occlusion.

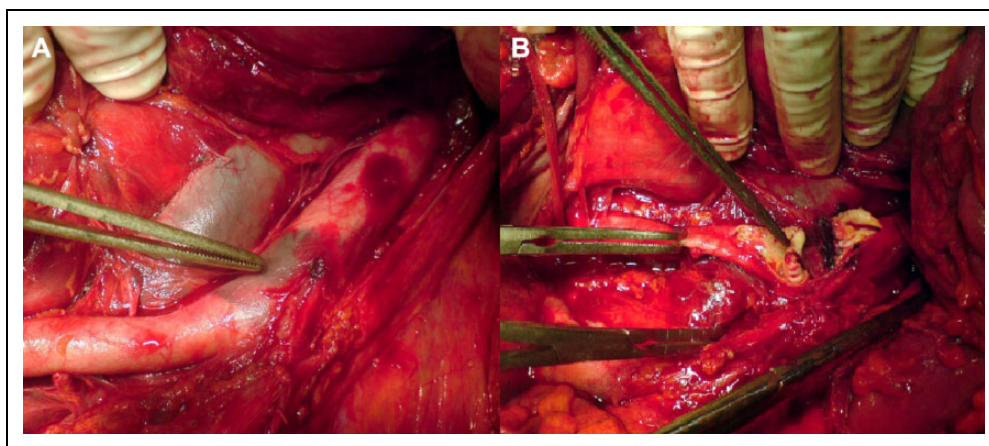


Figure 2. A, Terminal aorta with intimomedial flap (top of the forceps). Subadventitial hematoma beneath the thin anterior aortic wall. B, Circumferential intimomedial flap obstructing the orifice of the right common iliac artery (CIA). The remaining aortic wall represented with adventitia and thrombus above it.

As the endovascular stent graft was not available on the shelf, we decided to treat aortic arterial lesions by open surgical means. Explorative laparotomy revealed 2 traumatic perforations of ileum and transversal colon, and both defects were primarily sewn. The small retroperitoneal hematoma was observed at the level of aortic bifurcation, but with no signs of aortic rupture. Distal aorta wall showed 4-cm-long subadventitial hematoma with extremely thin adventitia (Figure 2A). After systemic administration of heparin (100 IU/kg), the longitudinal distal aortotomy extending to the proximal right CIA was performed. Extensive complete circumferential intimomedial dissection was identified. Dissected intimomedial flap served as a “competent valve” opening flow to left but blocking flow to the right CIA. Below the adventitia and outer media, parietal thrombus was present (Figure 2B). After tailoring of floppy part of the dissected intimomedial flap, the aortic wall was restored using a running 3-0 polypropylene suture, whereas dissected flap was replaced in predissection position. For securing the stability of dissected intimomedial flap to the

fragile posterior aortic wall adventitia, we used anterior longitudinal ligament (ALL) to strengthen the wall with every single bite of running suture (Figures 3 and 4). The suture line with incorporation of the ALL was 2 cm long. Although seemingly large, we have chosen 3-0 suture in order to maintain sufficient strength in incorporating ALL into the suture line. Due to heavy adhesions between the posterior aortic wall and ALL, additional aortic mobilization and ALL dissection could result in posterior aortic wall tear and finally conversion to open aortic graft replacement. No additional hemostatic agents were applied to the suture line. Thrombotic masses from CIA were removed with Fogarty catheters. Aorto-iliac longitudinal incision was closed using a great saphenous vein as a patch since this is an autologous material resistant to infection, easily obtainable from the inguinal region, providing very good results and allowing stent grafting of the aorta in case of any future problems encountered during the follow-up period. The muscle, because of its morbidity during the preparing and transfer, is not suitable in the case of infections. On the other

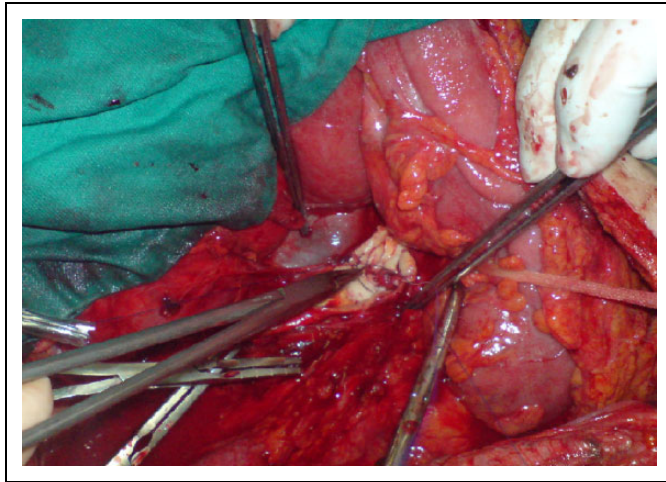


Figure 3. Suturing dissected intimomedial flap to the fragile adventitia of the posterior aortic wall using the anterior longitudinal ligament (ALL) with every single bite of running suture.

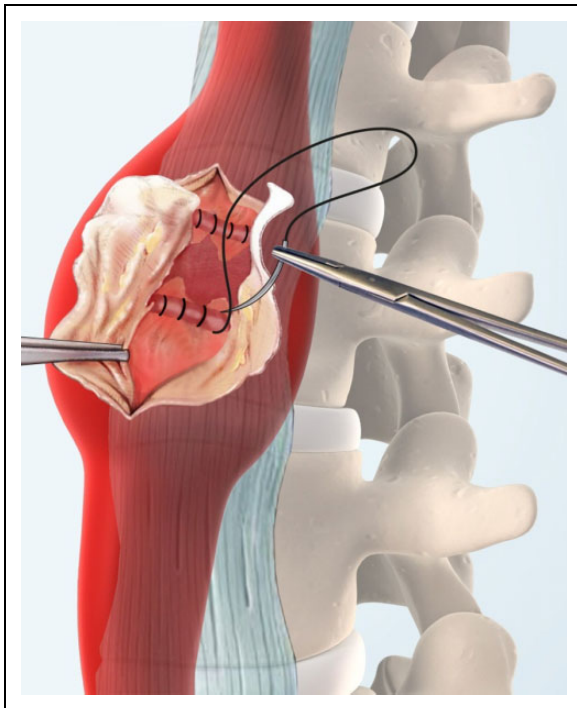


Figure 4. Schematic presentation of the injured aorta and anterior longitudinal ligament (ALL) and possibility of its use in strengthening of fragile posterior wall of the aorta.

hand, we did not cover the repair with omentum because of its previous use for covering of intestinal suture lines.

The postoperative course was uneventful. Postoperative low-molecular-weight heparin therapy was replaced with acetyl salicylic acid (300 mg/d). Control CTA performed on the third postoperative day showed regular perfusion of both iliac arteries with slight residual stenosis of the terminal aorta. Postoperative Duplex examination of leg arteries showed regular Doppler signal. Follow-up was scheduled as follows:

every 3 months color Doppler duplex examination and 6 months CTA. During the 8-year follow-up period, there were no signs of diminished leg perfusion and neither progression of residual terminal aorta stenosis nor degeneration of vein patch with aneurysmatic dilatation (Figure 5). All the presented data are accessible as they are archived in the medical record of presented patient.

Discussion

Blunt aortic injury (BAI) affects mostly thoracic part, and in 80% to 90% of cases, it is fatal.^{2,7-11} The frequency of BTAAD of the infrarenal aorta was historically 0.5%,¹² but recent series report frequency of 10% to 15%¹³ as a result of nonfatal head injuries due to motor vehicle safety improvements during the high-speed injuries.^{1,14,15} There is no agreement on adequate treatment of BAI. Surgical reparation is performed with flap suture, thromboendarterectomy, or synthetic graft replacement.^{3,16-19} In patients with sepsis, the lesion is treated with in situ allograft replacement or extra-anatomic bypass surgery with proximal anastomosis originating from the thoracic aorta or axillary artery.^{12,16,20} Endovascular repair is nowadays seen as a first-line treatment modality for BAI for the hemodynamically stable, but also for unstable patients with other multiple injuries (lung contusion, serial rib fractures, severe hip fractures, craniocerebral, spinal cord injuries).^{6,16,17}

In patients with blunt trauma, abdominal injuries are seen in up to 58%. Small and large bowel injury (with incidence up to 18% and 16%, respectively) might influence the surgical strategy for BAI. Some authors advise the use of endovascular prosthesis after initial laparotomy and subsequent surgical reparation of abdominal injuries.¹⁶ Due to potential infection of endograft, Yeh et al recommended surgical repair of the injured aorta or liberal use of endoprosthesis as a bridging procedure to definitive surgical repair.⁷

Herein, we describe in situ reparation of posttraumatic circumferential dissection with acute CIA occlusion. The cause of dissection is obvious: It was localized at the level of the third lumbar vertebra base prominence, suggesting a hammer and anvil mechanism of injury. The contributing factors were patient's thin body and focal calcifications on the posterior aortic wall. The other open surgical option for treatment was extra-anatomic bypass. The reasons not to use it were limited long-term graft patency, age of the patient, preservation and potential infection of aortic suture line, and the real risk of infection of bypass graft after its implantation. Acute limb ischemia, high risk of rupture of weakened aortic wall due to persistent hypertension, and highly suspected bowel perforation strongly indicated open repair. We intended to repair the dissection through fixation of the dissection flap. Unfortunately, the fixation of dissection directly to adventitia resulted in tearing of adventitia. To reinforce and strengthen the fragile posterior aortic wall, we used ALL which was widely taken with every single bite of returning continuous suture.

After initial suture, ALL was again taken into the returning running suture that at the end also involved proximal

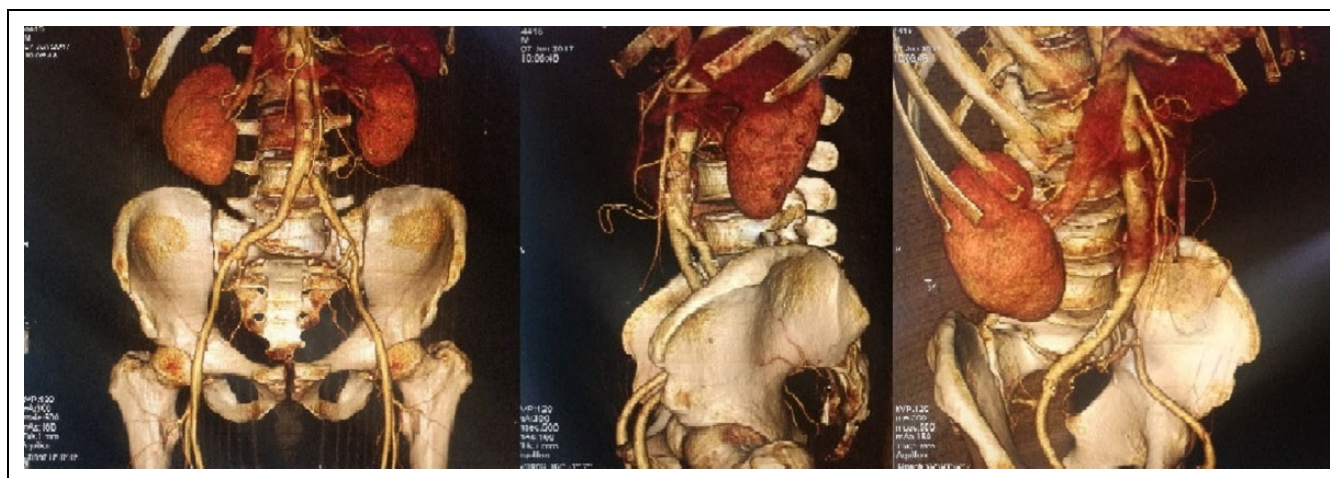


Figure 5. Computed tomography angiography (CTA) 8 years after initial treatment showing no signs of stenosis nor aneurysmatic dilatation of great saphenous vein patch.

intimomedial flap, hence providing smaller defect and better restitution of the aortic wall layers. The ALL is very hard to dissect without the interference with the integrity of the aortic wall and also avascular and hence at risk of infection. However, we used ALL out of necessity, and it was easy to handle without the unnecessary dissection using oblique interrupted sutures in order to spare the ligament fibers, and the bites with 3–4 mm distance enabling us to fold the ALL behind the posterior aortic wall. We did not have on the shelf neither bovine nor equine patches for use. Also, despite that the bovine pericardium is more resistant to infection than synthetic graft material, we did not want to use any xenogeneic material for the patient with peritonitis.

Guided by this experience, as a practical recommendation to vascular surgeons, it is very useful to note that the ALL is commonly incorporated into the posterior suture line of the graft to proximal aortic anastomosis of an open abdominal aortic aneurysm repair when the aortic neck is fragile. This case demonstrates that in situation of abdominal polytrauma with peritonitis, and no available endovascular tools on site, open surgical treatment of circumferential aortic dissection is possible and successful. Open surgical skills and modifications should be repetitively pointed out especially in the endovascular era. Described reinforcement of the posterior aortic wall to the ALL should be added to the armamentarium of aortic injury treatment.

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Declaration of Conflicting Interests

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